DISTILLATE

A KonSULT-based strategy
option generator

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Executive Summary

This report describes the development of the KonSULT tool as part of the Option Generation research that has been carried out as part of the DISTILLATE (Design and Implementation Support Tools for Integrated Local land Use, Transport and the Environment project). KonSULT is a knowledgebase which provides an assessment of the potential contribution to policy of some 42 transport and land use policy instruments, based on both a first principles assessment and a review of case studies. The option generator enables users to interrogate KonSULT to identify the subset of instruments which are likely to be most useful in a specified context. This output can then be used to create packages of policy instruments.

The KonSULT option generation tool is accessible to practitioners through the KonSULT webpage using the filter option:

http://www.konsult.leeds.ac.uk

Practitioners can focus on objectives, problems or performance indicators, specify their relative importance, indicate the overall strategy which they wish to pursue and identify the context in which they are working. The option generator will then use the assessment scores for each instrument in KonSULT to identify those instruments which are likely to contribute most. These tasks are completed through a series of linked pages that the practitioners work through. The result is a list of policy instruments that best fit the information input by the practitioner. This output can be saved.   The supplementary facility to develop policy packages uses the policy instrument list created by the practitioner in KonSULT and combines it with information from either a synergy or barrier matrix to create a list of ranked packages of pairs of instruments.

The tool has been structured so that the option generation process can be approached from the perspective of a national government, a regional government or a local authority.

One of the strengths of the tool is that practitioners have access to the breadth of knowledge within KonSULT.   Once the list of ranked policy instruments has been created practitioners can click on the policy instrument to go to the set of pages that provide more detailed information on each policy instrument.

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1 Introduction

This report describes one of the activities of the DISTILLATE research consortium in the area of option generation. The principal objective of DISTILLATE was to develop, through a focused, inter-disciplinary research programme, ways of overcoming the barriers to effective development and delivery of sustainable urban transport and land use strategies and, through them, enhanced quality of life. The consortium was initially set up with 16 local authority partners who would provide case studies and support for this work.[1] One of the first activities of the DISTILLATE research consortium was to conduct a detailed survey of the local authority partners to assess the barriers that they faced in developing and delivering sustainable urban transport and land use strategies (Hull and Tricker, 2005). One part of this survey focused on the issues surrounding option generation. It was found that half of the authorities surveyed considered the generation of strategy options problematic, while a quarter found generation of scheme options difficult. At a strategic level, national guidance and professional judgment dominated the sources of information, followed by stakeholder input, for generating options. Fewer than 25% identified option generation tools as currently making an important contribution. Dissatisfaction was greatest with the lack of available tools, followed by that with national guidance. Over half of those who responded thought it important to have access to option generation tools.

This review of local authorities confirmed the importance of a focus on option generation and, in particular, on tools for strategy option generation. The project pursued these issues initially through a literature review in transport and in other sectors presented in Jones and Lucas (2006). That review identified two broad types of approach: "inside the box" methods which are typically quantitative in nature and draw on pre-existing concepts and components, and "outside the box" methods which are typically qualitative and are able to identify radically different approaches (examples are provided in table 1). It was agreed as part of the DISTILLATE work to develop four specific option generation methods for further testing: two "inside the box" and two "outside the box" methods with one of each operating at the strategic and one of each at the scheme level.

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[1] Full details of the consortium are available at www.distillate.ac.uk

Table 1 Methods for outline option generation

Categories	Description	Approach	Examples
'Inside the Box'	Pre-existing solutions	Library based approaches	KonSULT(2007) VTPI (2007)
	Existing parameters new permutations	Morphological box approach	Road User Charging (Kocak et al, 2006), Aeronautics Zwicky (1947)
	Constrained options	Constrained by specific parameters	Priority Evaluator (Hoinville, 1971)
'Outside the Box'	Generating new forms of options including some new parameters	Structured Approaches	Mind/ cognitive mapping Six Thinking Hats (de Bono, 1985)
		Unstructured Approaches: Verbal stimuli	Brainstorming
		Unstructured Approaches: visual stimuli	Eureka (Townsend and Faviour, 1991)

Source: Adapted from Jones and Lucas (2006)

The four DISTILLATE Option Generation products are:
- A KonSULT-based strategy option generator;
- An "outside the box" accessibility strategy planning tool;
- A hands-on road space reallocation option generator designed for public involvement; and
- A toolkit for qualitative generation of scheme options to help disadvantaged and hard-to-reach users.

This report describes the first: 'A KonSULT-based strategy option generator', which is the "inside the box" strategic level option. This approach combines the library-based approach of KonSULT with a morphological box approach to producing packages of policy instruments.

The key focus of this product is KonSULT, which is an example of a library-based approach. Library-based approaches have been used for many years by decision makers seeking to solve specific problems or meet agreed policy objectives by referring to databases of evidence and research on policy instruments. There are a number of web-based library approaches currently used in the transport industry including KonSULT, the VTPI transport demand management encyclopaedia (VTPI, 2008) and the Nottingham online planning resources (McClintock, 2006). The key advantage of these library-based approaches is the wide selection of evidence that is brought together, so enabling a large number of options to be considered by transport planners. The key disadvantage is that there may be solutions not in the database that would be more suitable for the specific objectives or locations that are being considered.

Morphological box analysis was first developed by Fritz Zwicky (Zwicky, 1947) as a structure for systematically identifying the complete set of potential permutations for designing a particular aeronautical system. Current applications of morphological analysis utilise this basic methodology to provide a structure to illustrate the range of choices available for a particular instrument or strategy. Once all the options are identified and input into the matrix (morphological box) and any infeasible options eliminated it is then easier to consider all the potential combinations that could be used to design a particular policy and also identify where the gaps exist in the current options available. The main challenge with the morphological box approach is to narrow down the very large number of potential combinations by rejecting infeasible sub sets of combinations. This methodology has been recently transferred to the transport planning sector through the work presented in Kocak et al (2006). They developed a web-based tool to assist local authorities in the UK to investigate the suitability and then the possible design of a road user charging scheme for their local area. This approach relies on decision makers knowing all the possible permutations (policy parameters) making use of the library based approach to generate this information. Its advantage is that it allows options that are infeasible for specific criteria to be removed from the decision and at the same time potentially creating new permutations that have not previously been considered by decision makers.

Two key activities were planned as part of this work. The first task was to incorporate the Decision Makers' Guidebook (May et al, 2005) into the KonSULT website. The second task was to develop the filter system that was currently in place in KonSULT, so that it was more capable of being utilised as a realistic option generation tool at the strategy level. This second task combines the two approaches described above, by developing the existing library based approach within KonSULT and adding to this a morphological approach to creating packages of policy instruments.

The remaining structure of the report is as follows. Section two provides a description of KonSULT. Section three provides a brief description of the Decision Makers' Guidebook (May et al, 2005). Section four describes the old KonSULT Filter. Section five describes the modifications that were made to this to develop the new tool. Section six provides a description of the development of the supplementary tool that allows pairs of instruments to be developed into packages. Section seven provides a step by step run through using the tool. Section eight describes the testing of the tool and future work.

2 KonSULT

KonSULT is a web-based knowledgebase designed to provide up to date evidence on the performance of a wide range of transport and land use policy instruments. It is aimed at professional transport planners at all levels of responsibility, but also at decision-makers, interest groups and members of the public concerned about transport problems. It was developed with support from the UK Engineering and Physical Sciences Research Council (EPSRC), the UK Department for Transport (DfT), the Rees Jeffreys Road Fund and a number of specific research grants led by the University of Leeds with inputs

from many international partners. A more detailed description of its development can be found in Jopson et al (2004) and May and Taylor (2002).
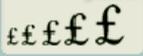
The list of 60 policy instruments for potential inclusion was developed on the basis of a taxonomy from earlier work by May and Still (2000) and extended by Matthews and May (2001). These instruments are grouped into six categories of: land use interventions; behavioural and attitudinal measures; infrastructure projects; management and operational measures; information provision; and pricing. To date the knowledgebase has been populated with 42 of the 60 instruments with new information added when it becomes available (www.konsult.leeds.ac.uk).

A consistent approach has been undertaken for describing the structure of each instrument. This covers:
- a taxonomy and description, which defines the instrument, its aims and technological requirements;
- a first principles assessment which looks at why that instrument should be introduced, considers its anticipated demand and supply impacts, assesses the resulting positive or negative contributions to key policy objectives and problems, and identifies likely winners or losers and barriers to implementation;
- evidence on performance, illustrated by a series of case studies describing specific interventions, and empirical evidence on their impacts on the same set of objectives and problems examined within the first principles assessment;
- a summary of the contribution which the instrument is expected to make and the contexts in which it is likely to be most effective;
- an identified set of complementary instruments that would work well with the selected instrument by helping to overcome barriers or enhance its positive impacts.

To illustrate the impacts of each instrument and ensure a consistent methodology the same lists of demand and supply impacts, objectives, problems, barriers, and contexts are used to assess each instrument. The contribution of each policy instrument to each of these is assessed on a common eleven-point scale illustrated in Figure 1. The scores assigned are judgmental rather than evaluative, and take account of qualitative and quantified performance, public perceptions and professional assessments. They are thus designed not to replace a formal cost-benefit analysis but to suggest policy instruments, which might be developed for subsequent more detailed appraisal.

Figure 1: An example of the instrument contribution scores

Objective	Scale of contribution	Comment
Efficiency	XXXXX✓✓✓✓	By reducing motor traffic
Liveable streets	XXXXX✓✓✓✓	By reducing motor traffic
Protection of the environment	XXXXX✓✓✓✓	By reducing motor traffic
Equity and social inclusion	XXXXX✓✓✓✓	Through increased accessibility
Safety	XXXXX✓✓✓✓	By reducing motor traffic
Economic growth ££££££	XXXXX✓✓✓✓	More attractive location
Finance £	?	Uncertain effect

✓ = Weakest possible positive contribution,   ✓✓✓✓ = strongest possible positive contribution
X = Weakest possible negative contribution   XXXXX = strongest possible negative contribution
XXXXX✓✓✓✓ = No contribution

3   KonSULT – A Decision Makers Guidebook

The Decision Makers Guidebook (May et al, 2005) was first published in 2003, as a guidebook for developing sustainable urban land use and transport strategies. The Guidebook was updated in 2005 to reflect the findings of the EC Fifth Framework Land Use and Transport Research programme (www.lutr.net). It was available in a number of different languages but not electronically. It was decided as part of the DISTILLATE work that this guidebook should be included on the KonSULT website to aid wider access, as the guidelines were relevant to all of the projects in DISTILLATE. The guidebook can now be accessed through the following web link:
http://www.konsult.leeds.ac.uk/public/level1/sec00/index.htm.
Each of the original chapters of the guidebook is listed separately in KonSULT. These are:
1. Outline of the Guidebook
2. The Challenge of Sustainable Mobility
3. The decision making context
4. Approaches to Decision making
5. Participation
6. A logical structure
7. Objectives, indicators and targets
8. Problem identification
9. Policy Instruments
10. Barriers to implementation
11. Strategy Formulation
12. Predicting impacts
13. Appraisal
14. Optimisation
15. Implementation, Evaluation and monitoring
16. Case studies
17. Glossary
18. References

In particular sections 6, 7, 8, 9, 10, 11 and 12 have been influential in developing the key task for the development of the KonSULT-based strategy option generator, which is described in the following section.

4   The original KonSULT Option Generation filter

The main task within the development of this product was to develop the existing filter system into an option generation facility. This development process will now be described. An earlier stage of this process was described in May et al (2007).

4.1 Structure of the filter

Within KonSULT, users had the option to search for a suitable policy instrument using a series of drop down menus, a key word search for a policy

instrument, hyperlinks from the complementary instruments section or a filter search. The filter search facility, which was only developed for 10 instruments, formed the basis of the option generation tool. Figure 2 shows the front end to the filter search facility. Users were required to select their user type (e.g. government official or service operator) and the objectives and problems which motivated their search for solutions. They could also select the strategy that they were considering (e.g. reducing the need to travel) and the area type that they were considering (e.g. city centre or corridor). Based on the options selected KonSULT produced a ranked list of policy instruments (see figure 3). This ranked list is provided as a list of the most suitable options given the criteria selected.

The ranking system for the filter was based on a simple additive rule for all the attributes which the user had specified. Each of the policy instruments within KonSULT has been rated on an eleven point scale (-5 to +5) as to how suitable they are for the given objectives, problems and strategies (e.g. see figure 1). In addition to this the user types and area types were previously assessed on a scale of +10 if the policy instrument is suitable for that user type or 0 if not. The overall score is then calculated by summing all the options selected for each policy instrument within the database. The higher the score the more suitable the policy instrument is assumed to be for the criteria selected. Figure 3 shows a typical result of this ranking system. In this case the policy of road user charging was judged as the most suitable policy for the given criteria.

Figure 2 Initial KonSULT filter

Figure 3 Ranked list of policy options from the KonSULT filter

Filter

Road user charging
User Type: Government official, Service operator, User group, Campaigner
Relevance: 33

Company travel plans
User Type: Government official, User group, Campaigner
Relevance: 25

Guided bus
User Type: Government official, Service operator, Campaigner
Relevance: 25

Parking controls
User Type: Government official, User group, Campaigner
Relevance: 24

Regulatory restrictions
User Type: Government official, Service operator, User group, Campaigner
Relevance: 24

Ride sharing
User Type: Government official, User group, Campaigner
Relevance: 23

Physical restrictions
User Type: Government official, Service operator, User group, Campaigner
Relevance: 22

Individualised marketing campaigns
User Type: Government official, Service operator, User group, Campaigner
Relevance: 20

Car clubs
User Type: Government official, User group, Campaigner
Relevance: 19

Flexible working hours
User Type: Government official, Service operator, User group
Relevance: 16

4.2 Weaknesses of this approach

While the KonSULT filter was identified as a potentially useful option generation tool, a number of weaknesses were identified in the approach. These were:
   a) only 10 policy instruments had been included in the filter;
   b) it was inflexible in its design;
   c) the implications for different user types were unclear;
   d) the listing of area types was somewhat inconsistent, and it was unclear how instruments could be selected for different areas in ways which achieved some spatial consistency;
   e) the ability to select both objectives and problems led to a degree of double counting;
   f) there was no facility for identifying the relative importance of different objectives (or problems);

g) there had been a growing emphasis on the use of indicators and targets (Marsden et al, 2006), yet users were unable to select or prioritise indicators;

h) it used a simple additive rule for the scores for all the attributes which the user specified; this led to inconsistencies in the shortlisted instruments and their performance scores

i) it was possible to select all boxes and achieve higher scores

j) there was no consideration of the potential cost of the scheme

k) there was no function to save the output list and input criteria.

l) there was no function to consider packages of instruments.

In order to deal with these issues it was agreed that further work was needed to overcome these weaknesses and hence strengthen the role of KonSULT as an option generation tool.

5 The KonSULT – based Option Generation Tool: Development

The approach taken within the DISTILLATE Option Generation project has been to address the identified weaknesses surrounding the original filter. This has been tackled in two stages. Firstly, a new upgraded policy instrument option generation tool has been developed within the KonSULT webpage. Secondly, a policy package *add on* has been created that uses the output from the KonSULT tool to create potential policy packages of pairs of policy instruments, which is described in section 6. This development will now be described in more detail by considering how each of the weaknesses described in section 4.2 were resolved.

5.1 Development of KonSULT

5.1.1 Policy instruments included in the tool

The first identified weakness of the original filter was that there were only 10 potential policy instruments that could be ranked, therefore restricting the usefulness of the filter in selecting the right options for the user for the criteria input. This has been improved and there are now 42 policy instruments contained within the tool (see table 2).

5.1.2 Inflexible design

The second identified weakness was that the filter was very inflexible in design, which made it hard to add in additional policy instruments from the website to the filter. This has been improved with a database being developed that provides the background information to the tool enabling the addition of future policy instruments to be made easily. Previously all the data had to be encoded into the filter script.

Table 2 Policy Instruments contained within the KonSULT option generation tool

Number	Policy Instrument
1	Public Transport (PT) Focused Development
2	Parking Standards
3	Development Densities Mix
4	Car Clubs
5	Company Travel Plans
6	Individualised marketing
7	Flexible working hours
8	Telecommunications
9	Ride Sharing
10	Guided Bus
11	Park & Ride
12	New off street parking
13	New Rail Stations
14	New Rail Services on existing Lines
15	Light Rail Systems
16	Cycle Routes
17	Accident Remedial
18	Traffic Calming
19	Urban Traffic Control (UTC)
20	Information Technology Systems (ITS)
21	Physical Restrictions
22	Parking Controls
23	Regulatory Restrictions
24	High Occupancy Vehicle (HOV) lanes
25	Cycle lanes and priorities
26	Cycle parking provision
27	Pedestrian crossing facilities
28	Lorry Routes and Bans
29	Lorry Fleet Management
30	Bus Fleet Management Systems
31	Public Transport Service Levels
32	Parking Guidance & information systems
33	Conventional signs and markings
34	Variable Message Signs
35	Private parking charges
36	Vehicle ownership taxes
37	Fuel taxes
38	Parking Charges
39	Fare levels (decrease)
40	Fares levels (increase)
41	Concessionary fares
42	Road pricing

5.1.3 User types

Under the previous filter the user had the option of selecting whether they were a Government Official, Service Operator, User Group or Campaigner. These user types have been reviewed and reorganised for the option generation tool as:

- Decision makers from national organisations (e.g., government, regulatory bodies, highways agencies)
- Decision makers from regional organisations (e.g., regional assemblies, development agencies)
- Local authority decision makers (e.g., city councils, local land use and transport planners).

The reason for having a user group is to identify only those policy instruments that the user has the ability to directly influence and implement. For example, currently in the UK road tax is a policy tool that only the national government can modify, whereas parking charges are the responsibility of the local authority.

A binary (1, 0) code against each policy instrument indicates whether it is available to each of the specified user types (1 if suitable).

5.1.4 Area types

Under the previous filter the user had the option of selecting which specific area type they were considering or they could select all boxes (as shown in Figure 2). The list of area types was felt to be inconsistent and unclear spatially. The scoring system used was that if a policy instrument was suitable for a particular area type then +10 was added to the score. Therefore if multiple boxes were ticked a potentially high score was achievable before any objectives or problems had been selected.

The area types were reviewed and re-organised for the option generation tool. The user is now able to select one area type, either by settlement type (large town or city >100k; small town or city <100k), or city area (town or city centre, inner suburb, outer suburb, district centre, corridor), or to specify "any area type".

The scoring system has also been improved. The tool draws on the KonSULT assessment of the potential effectiveness of a given instrument in the specified spatial context, which uses a -5 to + 5 rating scale. Each policy instrument is scored on the scale of -5 to + 5 indicating how suitable they are for each of the area types. This scale has then been converted to a 0 -1 scaled (normalised) for the filter search. If "any area type" is selected a normalised default score of 1 is used.

5.1.5 The treatment of objectives, problems, indicators and strategy

The key problems under the old filter were that users had the ability to select any number of objectives and problems leading, in some cases, to the potential for double counting. For example, the objective of safety and the problem of accidents are very similar in their focus. In addition to this it had been noted that while there was the functionality for the user to include any number of objectives or problems, there was previously no ability to be able to weight the importance of these choices. For example, a local authority might be concerned with the objectives of improving safety and economic growth, so would have selected both of those. However given the choice they might have chosen to give economic growth a higher weighting in the decision. In addition to these issues was the concern that in the UK there was a growing emphasis on the use of indicators and targets at a local level, yet the ability to select appropriate indicators was not available in the filter.

This area saw the greatest level of development. Firstly, the category of indicators was added alongside the options of objectives and problems. The set of objectives and problems that users had the ability to select from was kept the same as the original filter. A new set of outcome and intermediate indicators was developed based on the work of the DISTILLATE Indicators project (Marsden et al, 2006, Marsden et al, 2005). The new set of indicators that are included in the tool are:

1. Congestion
2. Bus reliability
3. Percentage of people who think it is easy and safe to walk in their area
4. Carbon Dioxide (CO_2) emissions
5. Local Pollution
6. Energy Efficiency (per trip)
7. Accessibility to key services
8. Average cost of the journey
9. Mode share walk
10. Mode share cycle
11. Safety
12. Regional Gross Domestic Product (GDP).

For each of the 42 policy instruments in the KonSULT database an assessment was made on the scale of -5 to +5 as to how they would contribute to each of these 12 indicators. In addition to this the existing assessment for objectives and problems were reviewed for each policy instrument and changes made.

Secondly, the interface was designed so that users can only select from one of the lists (objectives, problems or indicators). This was done to reduce the problem of double counting. This is shown in Figure 4.

Thirdly, users are now able to select multiple options from their chosen list, and are then given the opportunity to weight their selected objectives (or problems, or indicators) in terms of relative importance to them. The weighting

system uses a score of 1 to 5 (5 = high importance, 1 = low importance), with weightings then being normalised to give weights summing to 1. The default is that all selected objectives (or problems, or indicators) have equal weights summing to 1.

Figure 4 Problems, objectives and indicators

5.1.6 Strategies

A similar weighting structure has been added to the strategy element. The user is able to select one or more strategies (*see Figure 5)* and if more than one is selected the user then has the opportunity to weight them. The scoring operates the same as for objectives, problems or indicators. Where no strategy is specified a default score of 1 is used.

Figure 5 Strategies

5.1.7 Calculation of overall score

Under the old filter a simple additive formula was used. This created the problem described in weakness i) where it was possible to increase the total score for an instrument if more boxes were ticked. A more sophisticated scoring formula has now been developed as part of the project for aggregating all the criteria. The formula is provided in Figure 6.

Figure 6 Formula for calculating the score

The overall score for policy Instrument *I* is calculated using equation A.

$$Score_I = 100 * UserType_I * AreaType_I * Objective_I * Strategy_I \qquad \text{Equation A}$$

Where *I* is the instrument of concern. Note that depending on the user's selection, *Objective_I* can be replaced by *Indicator_I* or *Problem_I*.

The user type score is based on a simple binary selection:

$$UserType_I = (0,1) \qquad \text{Equation B}$$

The area type score is based on a normalised scale:

$$AreaType_I = (0 \le AreaType_I \le 1) \qquad \text{Equation C}$$

The objectives (or problems or indicators) score is based on:

$$Objective_I = \sum_o W_o * O_I \qquad \text{Equation D}$$

where $\sum_o W_o = 1$ \qquad \text{Equation E}

and $-1 < O_I < 1$ \qquad \text{Equation F}

Where W_o is the weight for Objective *O and O_I* is the objective score for instrument *I*.

The strategy score is weighted in a similar way using weights W_S for strategy *S* and scores S_I for instrument *I*.

5.1.8 Output

Under the old system the policy instruments were presented as a list of ranked policy instruments. It was then possible to click to the more detailed information on the policy instruments based on the information contained within KonSULT. While the link back to each policy instruments more detailed information remains, the output package functions have changed in a number of ways, as shown in Figure 7. These are:

- It is now possible to save the output file to disk;
- An indication of the cost of each of the potential policy instruments has been included; this is a simple indication of whether the instrument involves new (high cost) infrastructure; is of medium, but often continuing, operating cost; is inexpensive to implement and operate; or generates revenue and is thus counted as being of neutral cost;
- It is possible to restrict the number of policy instruments presented;
- It is possible to limit the instruments presented by policy type (e.g. just pricing measures); and
- It is possible to present only those policy instruments above a specific score (e.g. greater than 0).

Figure 7 Output from KonSULT
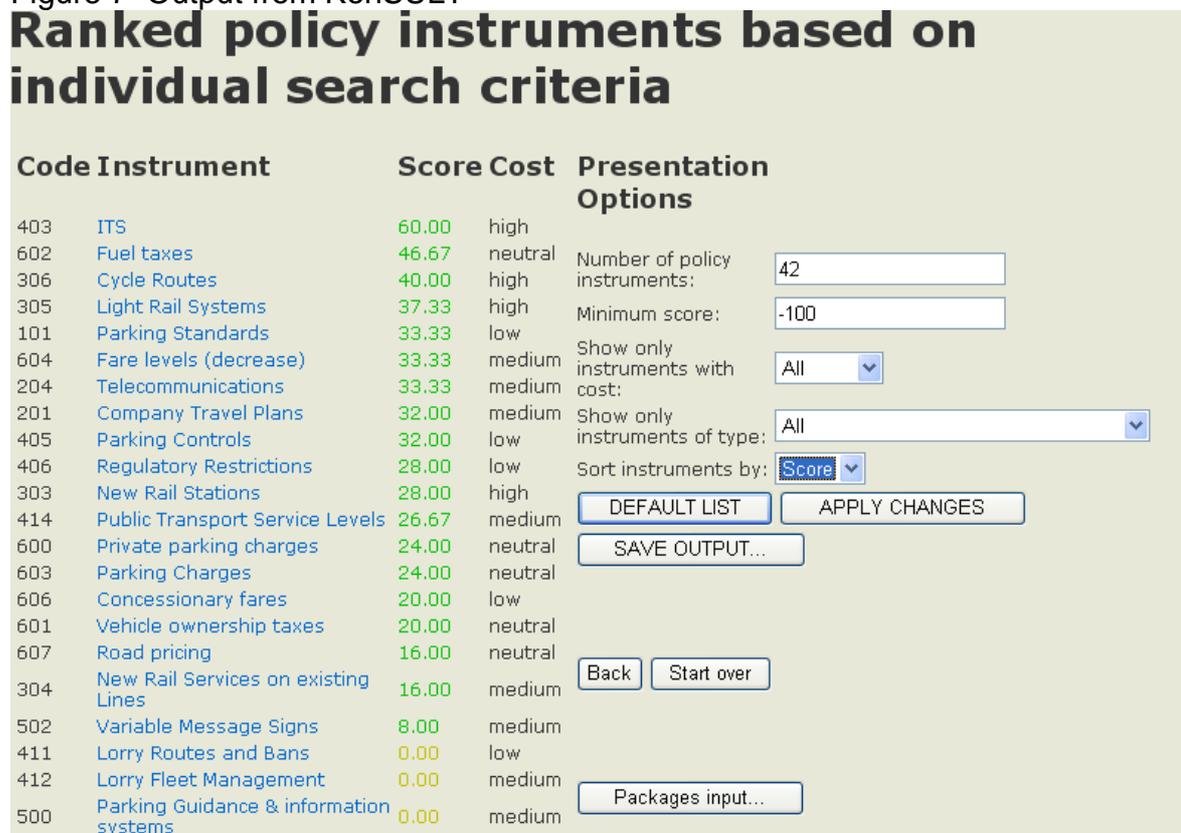
6 Packages of Instruments

One of the key restrictions of the previous filter was that it was only possible to present a list of individual policy instruments considered in isolation. It has been long known that there can be benefits from introducing packages of measures. Table 3 provides the expected interaction effects if two policy instruments of different types are combined (taken from May et al, 2005). For example management instruments can contribute to infrastructure instruments by reinforcing benefits, reducing political barriers and compensating losers. Within KonSULT there is a section within each policy instrument

(*complementary instruments*) that identifies other policy instruments which might complement the instrument in question by:

- Overcoming barriers;
- Overcoming political barriers;
- Compensating losers; and
- Reinforcing benefits.

The first three of these are only addressed where such barriers are identified for the instrument in question.

Table 3 Interaction matrix

These Instruments	Contribute to these instruments in the ways shown					
	Land use	Infrastructure	Management	Information	Attitudes	Pricing
Land use		✳				✳
Infrastructure	✳✚		◉			◉
Management	✳✚	✳◉✚			✳	✳◉✚
Information	✳	✳◉	✳◉✚		✳	✳◉✚
Attitudes	✳◉	✳◉	✳◉			◉
Pricing	✳✚	✳◈✚	✳◈✚	◈◉	✳	

Key: ✳ benefits reinforced   ◈ financial barriers reduced
        ◉ political barriers reduced   ✚ compensation for losers
Source: May et al (2005)

Most approaches to creating packages of policy instruments focus on two key principles, firstly the pursuit of synergy and secondly the removal of barriers. "Synergy occurs when the simultaneous use of two or more instruments gives a greater benefit than the sum of the benefits of using either one of them alone" (May et al, 2006). The removal of barriers implies identifying factors which hinder the implementation of an otherwise desirable policy instrument, and using a second instrument to overcome them.

The second stage of the KonSULT development uses the approach of defining pairs of policy instruments from the KonSULT output based either on their potential synergy effects or their ability to reduce barriers to either instrument. For this purpose the matrix in table 3 was used.

The packages tool is an Excel (.xls) tool. The inputs to the tool are:
1. The output file from KonSULT including policy instrument code, name, category and score (see figure 7); and
2. A synergy or barrier matrix.

Synergy Matrix

The first matrix reflects synergy. Since the evidence suggests that true synergy rarely occurs (see May et al, 2006), all values are negative. Most cells in Table 3 show the "reinforcing benefits" symbol, so this has been used to assess the scale of that reinforcement, using three scores of -5 (high), -10 (medium) and -20 (low). The results of this matrix are provided in Table 4.

The same score has been applied to all instruments within one category when combined with those in another category.

Table 4 Matrix 1: synergy

	Land use	Infrastructure	Management	Information	Attitudes	Pricing
Land use						
Infrastructure	-20					
Management	-20	-10				
Information	-20	-10	-5			
Attitudes	-20	-20	-10	-20		
Pricing	-20	-10	-5	-5	-10	

Removing barriers

The second matrix reflects contributions to removing barriers. This has been constructed by focusing on the number of symbols for acceptability, finance and compensation of losers in each of the cells in Table 3. Two cells have no such symbols, and score zero. The score is +5 for one symbol, +10 for two and +20 for three. The matrix developed from these rules is shown in Table 5.

Table 5 Matrix 2: overcoming barriers

	Land use	Infrastructure	Management	Information	Attitudes	Pricing
Land use						
Infrastructure	+5					
Management	+5	+10				
Information	0	+5	+10			
Attitudes	+5	+5	+5	0		
Pricing	+5	+20	+20	+20	+5	

There are four stages in developing the packages:

Stage 1 – Input KonSULT data

Stage 2 - Select appropriate interaction matrix

Stage 3 – Once the data has been input, the user has the option to deselect policy instruments that they consider are unsuitable and add other policy instruments that would be suitable. For example figure 8 shows that at the moment only 10 policy instruments are being considered for the policy packages.

Figure 8 KonSULT output inputted into the packages tool

Stage 4 - The tool takes the policy instruments selected and creates all the potential combinations of packages that are possible. The ranking of policy instruments is created using the following formula:

Total Score = Instrument 1 score + instrument 2 score + selected interaction matrix score

The output of stage 4 is provided in Figure 9, which shows which policy instrument packages scored the best based on:

a) The criteria inputted by the user in KonSULT
b) The policy instruments selected to be included in the packages assessment
c) The matrix used (synergy or barriers)

The information provided in Figure 9 can be saved as either a .xls, .csv or .txt file. In this example the policy package combination that achieved the highest combined score was: cycle routes and accident remedial measures.

While this functionality is not automated in the KonSULT tool it would be possible once the output has been saved to select one specific policy instrument (e.g. road user charging) and just look at those policy instruments that were combined with it and assess which would be the most suitable.

Figure 9 Output of Packages

New Rank	Combin-ations	Instrument1	Score1	Cost1	Rank1	Category1	Instrument2	Score2	Cost2	Rank2	Category2	Combin-ed Score	Matrix Score	Total Score
1	306&400	Cycle Routes	22.8	high	4	Infrastructure	Accident Remedial	44.8	medium	1	Management	67.6	-10	57.6
2	400&607	Accident Remedial	44.8	medium	1	Management	Road pricing	14.4	neutral	6	Pricing	59.2	-5	54.2
3	102&400	Development Densitie	26.88	high	2	Land Use	Accident Remedial	44.8	medium	1	Management	71.68	-20	51.68
4	305&400	Light Rail Systems	16	high	5	Infrastructure	Accident Remedial	44.8	medium	1	Management	60.8	-10	50.8
5	400&502	Accident Remedial	44.8	medium	1	Management	Variable Message Sigi	7.2	medium	10	Information	52	-5	47
6	400&401	Accident Remedial	44.8	medium	1	Management	Traffic Calming	25.2	medium	3	Management	70	-30	40
7	306&401	Cycle Routes	22.8	high	4	Infrastructure	Traffic Calming	25.2	medium	3	Management	48	-10	38
8	100&400	PT Focused Developi	12	high	8	Land Use	Accident Remedial	44.8	medium	1	Management	56.8	-20	36.8
9	401&607	Traffic Calming	25.2	medium	3	Management	Road pricing	14.4	neutral	6	Pricing	39.6	-5	34.6
10	102&401	Development Densitie	26.88	high	2	Land Use	Traffic Calming	25.2	medium	3	Management	52.08	-20	32.08
11	305&401	Light Rail Systems	16	high	5	Infrastructure	Traffic Calming	25.2	medium	3	Management	41.2	-10	31.2
12	102&306	Development Densitie	26.88	high	2	Land Use	Cycle Routes	22.8	high	4	Infrastructure	49.68	-20	29.68
13	400&411	Accident Remedial	44.8	medium	1	Management	Lorry Routes and Bar	13.6	low	7	Management	58.4	-30	28.4
14	401&502	Traffic Calming	25.2	medium	3	Management	Variable Message Sigi	7.2	medium	10	Information	32.4	-5	27.4
15	306&607	Cycle Routes	22.8	high	4	Infrastructure	Road pricing	14.4	neutral	6	Pricing	37.2	-10	27.2
16	306&411	Cycle Routes	22.8	high	4	Infrastructure	Lorry Routes and Bar	13.6	low	7	Management	36.4	-10	26.4
17	400&403	Accident Remedial	44.8	medium	1	Management	ITS	9.6	high	9	Management	54.4	-30	24.4
18	411&607	Lorry Routes and Bar	13.6	low	7	Management	Road pricing	14.4	neutral	6	Pricing	28	-5	23
19	102&305	Development Densitie	26.88	high	2	Land Use	Light Rail Systems	16	high	5	Infrastructure	42.88	-20	22.88
20	306&403	Cycle Routes	22.8	high	4	Infrastructure	ITS	9.6	high	9	Management	32.4	-10	22.4
21	102&607	Development Densitie	26.88	high	2	Land Use	Road pricing	14.4	neutral	6	Pricing	41.28	-20	21.28
22	102&411	Development Densitie	26.88	high	2	Land Use	Lorry Routes and Bar	13.6	low	7	Management	40.48	-20	20.48
23	305&607	Light Rail Systems	16	high	5	Infrastructure	Road pricing	14.4	neutral	6	Pricing	30.4	-10	20.4
24	305&411	Light Rail Systems	16	high	5	Infrastructure	Lorry Routes and Bar	13.6	low	7	Management	29.6	-10	19.6

7 Example from Start to Finish

This section provides a step by step description of the complete tool.

Step 1 Select user type and area type.
In this case the user has selected *local authority decision maker* and *large town or city 100k.* They then click on *continue* to go to the next screen.

Step 2 Select either objectives, problems or indicators and then weight accordingly
In this case the user has specified the category of *Indicators* and has chosen to apply weights to the indicators of *congestion*, *CO_2 emissions*, *energy efficiency / trip* and *safety.*

Step 3 select a strategy or choose any strategy
In this case the user has specified *any strategy*

Step 4 Save outputs either as save output or as Packages input if you are going to use the add on tool.

Step 5 save the file in the correct folder for the policy package tool. Select the interaction matrix that is wanted. In this case the synergy matrix is being used.

Step 6 select/ deselect which policy instruments you want to include in the potential packages. In the example below all 42 policy instruments in the tool were originally included however, development densities mix, new rail stations, light rail stations and fare levels (decrease and increase) have been deselected.

OGid	Code	Instrument	Score	Cost	Category	Rank	Select
OG001	607	Road pricing	77.33	neutral	Pricing	1	SELECTED
OG002	402	UTC	62.67	medium	Management	2	SELECTED
OG003	403	ITS	62.67	high	Management	3	SELECTED
OG004	305	Light Rail Systems	50.67	high	Infrastructure	4	unselected
OG005	301	Park & Ride	45.33	high	Infrastructure	5	SELECTED
OG006	204	Telecommunications	44	medium	Attitudes	6	SELECTED
OG007	102	Development Densities Mix	43.73	high	Land Use	7	unselected
OG008	600	Private parking charges	40	neutral	Pricing	8	SELECTED
OG009	300	Guided Bus	37.33	high	Infrastructure	9	SELECTED
OG010	101	Parking Standards	36	low	Land Use	10	SELECTED
OG011	303	New Rail Stations	36	high	Infrastructure	11	unselected
OG012	603	Parking Charges	36	neutral	Pricing	12	SELECTED
OG013	100	PT Focused Development	35.2	high	Land Use	13	SELECTED
OG014	412	Lorry Fleet Management	35.2	medium	Management	14	SELECTED
OG015	413	Bus Fleet Management Systems	35.2	medium	Management	15	SELECTED
OG016	205	Ride Sharing	34.67	medium	Attitudes	16	SELECTED
OG017	405	Parking Controls	34.67	low	Management	17	SELECTED
OG018	500	Parking Guidance & information systems	34.67	medium	Information	18	SELECTED
OG019	202	Individualised marketing	33.33	medium	Attitudes	19	SELECTED
OG020	408	cycle lanes and priorities	29.87	medium	Management	20	SELECTED
OG021	304	New Rail Services on existing Lines	29.33	medium	Infrastructure	21	SELECTED
OG022	400	Accident Remedial	29.33	medium	Management	22	SELECTED
OG023	604	Fare levels (decrease)	29.33	medium	Pricing	23	unselected
OG024	200	Car Clubs	28	medium	Attitudes	24	SELECTED

Step 7 run the policy packages tool. The example outputs are provided below.

Start	Settings	KonSULT	Interaction	Pre-select	Select	Combinations	Save

Combinations of policy instruments

< Re-select	Save >
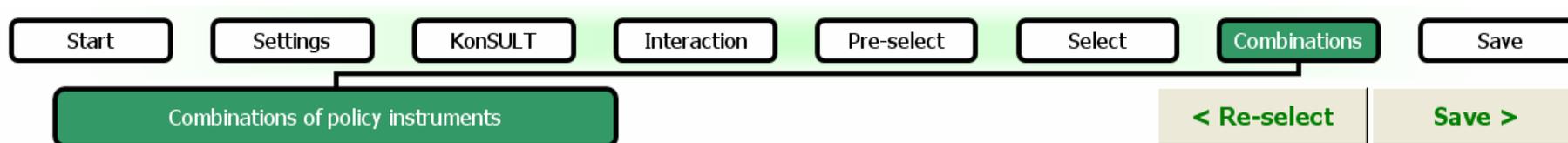
Unique combinations of policy instruments (Total Score = Instrument1 Score + Instrument2 Score + Interaction Matrix Score)

InteractionMatrix: 1
Combinations: 666

		Instrument1					Instrument2					Combinations		
New Rank	Combin-ations	Instrument1	Score1	Cost1	Rank1	Category1	Instrument2	Score2	Cost2	Rank2	Category2	Combin-ed Score	Matrix Score	Total Score
1	402&607	UTC	62.67	medium	2	Management	Road pricing	77.33	neutral	1	Pricing	140	-5	**135**
2	403&607	ITS	62.67	high	3	Management	Road pricing	77.33	neutral	1	Pricing	140	-5	**135**
3	301&607	Park & Ride	45.33	high	5	Infrastructure	Road pricing	77.33	neutral	1	Pricing	122.66	-10	**112.66**
4	204&607	Telecommunications	44	medium	6	Attitudes	Road pricing	77.33	neutral	1	Pricing	121.33	-10	**111.33**
5	412&607	Lorry Fleet Managem	35.2	medium	14	Management	Road pricing	77.33	neutral	1	Pricing	112.53	-5	**107.53**
6	413&607	Bus Fleet Manageme	35.2	medium	15	Management	Road pricing	77.33	neutral	1	Pricing	112.53	-5	**107.53**
7	405&607	Parking Controls	34.67	low	17	Management	Road pricing	77.33	neutral	1	Pricing	112	-5	**107**
8	500&607	Parking Guidance & in	34.67	medium	18	Information	Road pricing	77.33	neutral	1	Pricing	112	-5	**107**
9	300&607	Guided Bus	37.33	high	9	Infrastructure	Road pricing	77.33	neutral	1	Pricing	114.66	-10	**104.66**
10	408&607	cycle lanes and priorit	29.87	medium	20	Management	Road pricing	77.33	neutral	1	Pricing	107.2	-5	**102.2**
11	205&607	Ride Sharing	34.67	medium	16	Attitudes	Road pricing	77.33	neutral	1	Pricing	112	-10	**102**
12	400&607	Accident Remedial	29.33	medium	22	Management	Road pricing	77.33	neutral	1	Pricing	106.66	-5	**101.66**
13	202&607	Individualised marketi	33.33	medium	19	Attitudes	Road pricing	77.33	neutral	1	Pricing	110.66	-10	**100.66**
14	406&607	Regulatory Restriction	28	low	27	Management	Road pricing	77.33	neutral	1	Pricing	105.33	-5	**100.33**
15	407&607	HOV lanes	27.73	medium	29	Management	Road pricing	77.33	neutral	1	Pricing	105.06	-5	**100.06**
16	301&402	Park & Ride	45.33	high	5	Infrastructure	UTC	62.67	medium	2	Management	108	-10	**98**
17	301&403	Park & Ride	45.33	high	5	Infrastructure	ITS	62.67	high	3	Management	108	-10	**98**
18	402&600	UTC	62.67	medium	2	Management	Private parking charg	40	neutral	8	Pricing	102.67	-5	**97.67**
19	403&600	ITS	62.67	high	3	Management	Private parking charg	40	neutral	8	Pricing	102.67	-5	**97.67**
20	204&402	Telecommunications	44	medium	6	Attitudes	UTC	62.67	medium	2	Management	106.67	-10	**96.67**
21	204&403	Telecommunications	44	medium	6	Attitudes	ITS	62.67	high	3	Management	106.67	-10	**96.67**
22	304&607	New Rail Services on	29.33	medium	21	Infrastructure	Road pricing	77.33	neutral	1	Pricing	106.66	-10	**96.66**

Step 8 save the output

Step 9 Review the output. If only road pricing measures are required then the output can be viewed with just the road pricing combinations as provided in Table 6 (although this task would have to be completed manually). This test indicates that the most suitable complementary policy instrument for the road pricing criteria input is Urban Traffic Control (UTC) (see Table 6).

Table 6 Road pricing example

New Rank	Combin-ations	Instrument 1	Score 1	Category 1	Instrument 2	Score 2	Category 2	Combin-ed Score	Matrix Score	Total Score
1	402&607	UTC	62.67	Management	Road pricing	77.33	Pricing	140	-5	135
2	403&607	ITS	62.67	Management	Road pricing	77.33	Pricing	140	-5	135
3	301&607	Park & Ride	45.33	Infrastructure	Road pricing	77.33	Pricing	122.66	-10	112.7
4	204&607	Telecommunications	44	Attitudes	Road pricing	77.33	Pricing	121.33	-10	111.3
5	412&607	Lorry Fleet Management	35.2	Management	Road pricing	77.33	Pricing	112.53	-5	107.5
6	413&607	Bus Fleet Management Systems	35.2	Management	Road pricing	77.33	Pricing	112.53	-5	107.5
7	405&607	Parking Controls	34.67	Management	Road pricing	77.33	Pricing	112	-5	107
8	500&607	Parking Guidance & information systems	34.67	Information	Road pricing	77.33	Pricing	112	-5	107
9	300&607	Guided Bus	37.33	Infrastructure	Road pricing	77.33	Pricing	114.66	-10	104.7
10	408&607	cycle lanes and priorities	29.87	Management	Road pricing	77.33	Pricing	107.2	-5	102.2
11	205&607	Ride Sharing	34.67	Attitudes	Road pricing	77.33	Pricing	112	-10	102
12	400&607	Accident Remedial	29.33	Management	Road pricing	77.33	Pricing	106.66	-5	101.7
13	202&607	Individualised marketing	33.33	Attitudes	Road pricing	77.33	Pricing	110.66	-10	100.7
14	406&607	Regulatory Restrictions	28	Management	Road pricing	77.33	Pricing	105.33	-5	100.3
15	407&607	HOV lanes	27.73	Management	Road pricing	77.33	Pricing	105.06	-5	100.1
16	304&607	New Rail Services on existing Lines	29.33	Infrastructure	Road pricing	77.33	Pricing	106.66	-10	96.66
17	404&607	Physical Restrictions	24	Management	Road pricing	77.33	Pricing	101.33	-5	96.33
18	414&607	Public Transport Service Levels	24	Management	Road pricing	77.33	Pricing	101.33	-5	96.33
19	501&607	Conventional signs and markings	24	Information	Road pricing	77.33	Pricing	101.33	-5	96.33
20	200&607	Car Clubs	28	Attitudes	Road pricing	77.33	Pricing	105.33	-10	95.33
21	201&607	Company Travel Plans	28	Attitudes	Road pricing	77.33	Pricing	105.33	-10	95.33
22	306&607	Cycle Routes	28	Infrastructure	Road pricing	77.33	Pricing	105.33	-10	95.33
23	302&607	New off street parking	27.73	Infrastructure	Road pricing	77.33	Pricing	105.06	-10	95.06
24	401&607	Traffic Calming	21.33	Management	Road pricing	77.33	Pricing	98.66	-5	93.66
25	101&607	Parking Standards	36	Land Use	Road pricing	77.33	Pricing	113.33	-20	93.33
26	100&607	PT Focused Development	35.2	Land Use	Road pricing	77.33	Pricing	112.53	-20	92.53
27	411&607	Lorry Routes and Bans	19.2	Management	Road pricing	77.33	Pricing	96.53	-5	91.53
28	203&607	Flexible working hours	24	Attitudes	Road pricing	77.33	Pricing	101.33	-10	91.33
29	409&607	Cycle parking provision	16	Management	Road pricing	77.33	Pricing	93.33	-5	88.33
30	600&607	Private parking charges	40	Pricing	Road pricing	77.33	Pricing	117.33	-30	87.33
31	410&607	Pedestrian crossing facilities	13.33	Management	Road pricing	77.33	Pricing	90.66	-5	85.66
32	603&607	Parking Charges	36	Pricing	Road pricing	77.33	Pricing	113.33	-30	83.33
33	502&607	Variable Message Signs	0	Information	Road pricing	77.33	Pricing	77.33	-5	72.33
34	606&607	Concessionary fares	20	Pricing	Road pricing	77.33	Pricing	97.33	-30	67.33
35	601&607	Vehicle ownership taxes	0	Pricing	Road pricing	77.33	Pricing	77.33	-30	47.33
36	602&607	Fuel taxes	0	Pricing	Road pricing	77.33	Pricing	77.33	-30	47.33

8 Further work and testing

The policy package tool was designed as a prototype tool to assess whether it would be a suitable addition to the KonSULT filter. In testing it was found that users prefer a tool that could be incorporated into the KonSULT website so that additional programmes would not be required. This would require a more sophisticated web page functionality than is currently used for KonSULT.

The tool has been tested on a number of levels. The detailed matrix that backs up the KonSULT tool has been extensively tested to ensure that the programming that produces the final list of policy instruments and their respective scores is correct. In addition to this the KonSULT tool has been tested by a number of academics from around the world to determine whether the criteria that are input into the tool matches with the relative's scores for the policy instruments that result from it. These two levels of testing have gone successfully.

Testing with Transport professionals has highlighted that this is a potentially useful strategy option development tool. They have identified that it would be more user friendly to include the packages add on within the KonSULT website rather than requiring an additional tool. It has also been identified that the functionality for saving the results from the tool could be made more explicit. Saving the results currently allows users to save the output as a comma separated .txt file, which can then be opened in Microsoft packages including word and excel. If the user opens the file without using one of these packages the output does not look as user friendly. One option would be to state on this final page that the results require users to open the file using one of these packages. One of the advantages of saving the file is that it provides the full information on the options selected by the user so that they can compare directly the results of different choices made.

The next stage of the development of the KonSULT tool would be to develop a matrix that would allow three or more policy instruments to be combined into one policy package and an assessment made of the potential impacts. Further research is needed both on the impacts of combining two policy instruments and then in combining more than two.

While there are now 42 potential policy instruments in the option generation facility there are obviously more that could be added in the future given the necessary resource. As more evidence through case studies and research is available the scoring system should be updated over time as and when necessary.

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